CLAIMS

What is claimed is:

1. A control moment gyro (CMG) for use in a space vehicle, comprising:

a rotor adapted to rotate around a first CMG axis;

a gimbal supporting the rotor wherein the gimbal is able to rotate around a second CMG axis not parallel with the first axis;

a base supporting the gimbal wherein the base is able to rotate around a third axis not parallel with the second axis;

a mechanism for locking and unlocking the base to prevent or permit rotation thereof around the third axis; and

a drive mechanism coupled to the base for causing the base to rotate around the third axis when unlocked.

2. The CMG of claim 1 further comprising a mount adapted to rigidly attach to the vehicle and moveably couple to the base, wherein the drive mechanism acts between the base and the mount.

3. An apparatus for controlling spacecraft (S/C) momentum using control moment gyros (CMGs), comprising:

an array of three or more CMGs, each having a rotor adapted to rotate around a first axis, a gimbal supporting the rotor wherein the gimbal is able to rotate around a second axis not parallel to the first axis, and a base supporting the gimbal and rotor and able to rotate around a third axis not parallel to the second axis;

a releasable locking mechanism coupled to at least one of the CMGs for fixing the position of the base of the at least one CMG with respect to the spacecraft;

a drive associated with the base of the at least one CMG and able to cause rotation or other movement of the base of the at least one CMG with respect to the S/C when the locking mechanism is released; and

a controller coupled to the drive and the locking mechanism for receiving reorientation requests directed toward the CMG array and issuing commands to the locking mechanism to release and to the drive to cause movement of the at least one CMG with respect to the third axis.

4. The apparatus of claim 3 wherein the drive causes rotation of the at least one CMG around the third axis.

5. The apparatus of claim 3 wherein the drive causes rotation of the at least one CMG around the third axis and translation of the at least one CMG with respect to the S/C.

6. The apparatus of claim 3 wherein the drive is rotationally coupled between the S/C and the base of the at least one CMG so as to provide rotation of the base around the third axis.

7. The apparatus of claim 3 further comprising a bearing coupled between the S/C and the base facilitating relative movement thereof.

8. The apparatus of claim 3 wherein the locking mechanism is relocked after such movement.

9. The apparatus of claim 3 further comprising one or more sensors coupled to the at least one CMG and the controller for determining the amount of relative movement of the base of the at least one CMG with respect to the S/C.

10. The apparatus of claim 3 further comprising one or more sensors coupled to the S/C and to the controller for measuring one or more aspects of the S/C condition or attitude.

11. The apparatus of claim 10 further comprising a memory coupled to the controller for storing one or more parameters concerning a state of the at least one CMG.

12. The apparatus of claim 3 wherein the controller comprises a S/C attitude controller and a CMG controller.

13. The apparatus of claim 3 further comprising:

one or more sensors coupled to the at least one CMG and the controller for determining the amount of rotation of the at least one CMG about the third axis;

one or more sensors coupled to the S/C and to the controller for measuring one or more aspects of the S/C condition or attitude; and

memory coupled to the controller for storing data concerning the at least one CMG.

14. A method of improving momentum control of a space vehicle by reorienting a control moment gyro (CMG) array, comprising:

identifying which CMGs of the array are working;

determining an another array orientation having more favorable vehicle control characteristics;

releasing one or more locks fixing one or more of the CMGs in place in the array;

activating drive means for the one or more released CMGs to produce the another array orientation; and

engaging the one or more locks to once again fix the one or more CMGs in place in the another array orientation.

15. The method of claim 14 further comprising, prior to the releasing step:

determining the best vehicle state for array reorientation, and

adjusting CMG momentum for minimum negative vehicle impact during reorientation of the array.

16. The method of claim 14 further comprising, updating vehicle control parameters for the another array orientation.

17. The method of claim 14 prior to the determining step, first determining whether more favorable vehicle control characteristics can be obtained given the then current vehicle mass characteristics and the number of working CMGs.

18. The method of claim 14 wherein the determining step comprises determining more favorable control characteristics taking into account whether the space vehicle mass characteristics have changed since a prior array orientation was determined.

19. The method of claim 14 wherein the determining step comprises determining more favorable control characteristics after failure of a CMG of the array.

20. The method of claim 14 wherein the determining step comprises at least in part, retrieving pre-planned array reorientation data from memory.